centres; which centres are, in their turn, shown to be liberally supplied with blood-vessels capable of influencing the galvanic equilibrium. The accelerated respiration caused by increased muscular exertion is attributed to this cause. It is inferred, that the involuntary muscles are provided with apparatus within themselves, adapted to regulate their periodical galvanic discharge. The mutual reaction of distant parts is attributed to the fact of the whole body being included in one galvanic circle, which cannot be disturbed in a part without the whole participating proportionally in the effects.

February 10, 1848.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

"Examination of the Proximate Principles of the Lichens." By John Stenhouse, Esq., Ph.D.

The author, after adverting to the labours of Robiquet, Heeren, Dumas, and Kane in the investigation of the proximate principles of the lichens, especially of those which yield red colouring matter with ammonia, and also of the more recent inquirers on this subject, such as Schunck, Rochleder, Heldt and Knop, who have greatly extended our knowledge of this interesting but difficult department of organic research, proceeds to state that nearly two years ago his attention was directed by Dr. Pereira to a kind of Orcella weed, which had been recently imported into London from the Cape of Good Hope, but which had been rejected by the London archil manufacturers as being unfit for their use, from the small quantity of colouring matter it yields when subjected to the usual process. With a view to ascertain whether or not the red dyes obtained from the various lichens result from the action of ammonia on a certain crystalline principle, described by Schunck under the name of *lecanorine*, the author procured quantities of the several lichens usually employed by the archil makers, and subjected them to investigation; the minute details of which, together with the results, are given at length in the present paper.

The specimens examined are the following:—

I. *South American variety of* Roccella tinctoria.

The lichen was cut into small pieces and macerated with a large quantity of water for some hours, then quick-lime was added. A yellow solution was obtained, from which muriatic acid precipitated the colouring matter, as a bulky gelatinous mass; this was washed, dried on a plate of gypsum, and dissolved in hot spirits of wine (not boiling). The solution on cooling deposited the colouring principle in small white prismatic needles arranged in stars. This is—

1. *Alpha-Orsellic acid* (hydrated) ..... $C_{32} H_{15} O_{13} + HO$

and its salt of baryta—

Alpha-Orselliate of baryta ..... $C_{32} H_{15} O_{13} + BaO$

2. *Alpha-Orsellesic acid* was obtained by mixing crude gelatinous orsellic acid with a little water, neutralizing with lime or baryta, and precipitating with muriatic acid. A gelatinous hydrate is obtained, which may be purified by solution in dilute alcohol and crystallization.

The composition of this acid and its baryta salt is as follows :—

Alpha-Orsellesic acid ..... $C_{16} H_8 O_7 + HO$
Alpha-Orsellesiate of baryta $C_{16} H_8 O_7 + BaO$.

This acid gives a fugitive bluish-red or violet tint with hypochlorite of lime. Orsellic acid gives a deep blood-red tint, quickly changing to yellow.

3. *Orsellesic ether*, $C_{16} H_8 O_7 + C_4 H_5 O$, is obtained from alpha-orsellic acid by boiling in strong alcohol, evaporating to dryness, and dissolving in boiling water. It crystallizes on cooling in long flat needles, having a yellowish colour from adhering resin.

II. Roccella tinctoria *from the Cape of Good Hope.*

By processes similar to those just mentioned, this lichen yielded—

1. *Beta-Orsellic acid*..... $C_{34} H_{17} O_{14} + HO$
Beta-Orselliate of baryta .... $C_{34} H_{17} O_{14} + BaO$.

2. *Beta-Orsellesic acid* (formula to be given hereafter).

3. An ether compound, which is probably orsellesic ether. By three experiments its composition was found to be—

	I.	II.	III.
C	60·82	60·75	60·83
H	6·27	6·15	6·27
O	32·91	33·10	33·00
	100·00	100·00	100·00

4. *Roccellinin.*—Obtained by drying the gelatinous mass which is precipitated from the lime solution by muriatic acid, and boiling in strong spirit. The ether compound dissolves, and roccellinin remains behind. It is purified by repeated crystallization from strong spirit, aided by animal charcoal, and presents itself in soft hair-like crystals about an inch long, arranged in stars. It is a very indifferent substance, appearing however to be a feeble acid.

Its empirical formula is $C_{38} H_{17} O_{15}$.

III. *Roccella Montagnei.*

By similar treatment yielded—

1. *Erythric acid*..... $C_{20} H_{10} O_9 + HO$.

This acid gives a blood-red colour with hypochlorite of lime.

2. *Erythric ether* ..... $C_{20} H_{10} O_9 + C_4 H_5 O$.
3. *Erythric methylic ether* $C_{20} H_{10} O_9 + C_2 H_3 O$.

This ether crystallizes in longer and narrower prisms than erythric ether.

4. *Erythrelesic acid* is analogous to alpha- and beta-orsellesic acids.

5. *Picro-erythrin.*—By neutralizing erythric acid with lime or

baryta, and throwing down erythrelesic acid with muriatic acid, a mother-liquid is obtained containing picro-erythrin, from which that substance may be separated in the form of yellowish crystals; and these may be purified and decolorized by repeated crystallization from hot water aided by the use of animal charcoal. Picro-erythrin gives a blood-red colour with hypochlorite of lime.

Its empirical formula is $C_{34} H_{24} O_{20}$.

6. *Pseudo-orcin*, of which the empirical formula is $C_{10} H_{13} O_{10}$. It is obtained by boiling the lime solution of *R. Montagnei* till it is reduced to one-fourth of its bulk, passing carbonic acid in excess through the liquid, and evaporating the filtered liquid to the consistence of a syrup; this is introduced into a flask and digested with a large quantity of ether, which dissolves orcin and leaves pseudo-orcin. On being crystallized two or three times from strong spirit, it is obtained in large shining colourless crystals. Still larger crystals may be obtained from an aqueous solution. Hypochlorite of lime has no action upon it.

The author then gives a mode of extracting the colouring principles of the lichens, so as to make them portable for commercial purposes. The extraction might be performed in the country where the lichens grow, by cutting them up into small pieces, macerating in milk of lime, neutralizing with muriatic or acetic acid, collecting the gelatinous precipitate on cloths, and drying it at a gentle heat.

He also suggests two modes of estimating the quantity of colouring matter in the lichens.

1. By macerating a known quantity of the lichen in milk of lime, and adding bleaching powder of known strength from an alkalimeter till all colour disappears from the liquid, and noting the quantity of solution required. It is thus found that—

Angola lichen requires.....	200	measures	1·00
American lichen requires.....	120	..	0·60
Cape lichen requires.....	35	..	0·17
Lecanora Tartarea (from Germany, near Giessen) requires.....	25	..	0·12

2. By extracting the lichen with milk of lime, precipitating with acetic acid, collecting the precipitate on a weighed filter, drying and weighing it.

IV. *Evernia Prunastri.*

1. *Evernic acid* is obtained by extracting the lichen with milk of lime, precipitating with muriatic acid, drying the precipitate, and digesting in weak spirit till nearly two-thirds are dissolved. The solution yields crystals of *evernic acid.* The insoluble part is usnic acid. Evernic acid yields only a slight yellow colour with hypochlorite of lime.

Formula of hydrated *evernic* acid ..	$C_{34} H_{15} O_{13} + HO$
Formula of everniate of potash	$C_{34} H_{15} O_{13} + KO$
Formula of everniate of baryta	$C_{34} H_{15} O_{13} + BaO + Aq.$

2. *Evernesic acid* is obtained by dissolving evernic acid in a slight

excess of caustic potash, passing carbonic acid gas through the solution to saturation, and concentrating the solution: evernesiate of potash crystallizes out. From this the acid may be separated by means of muriatic acid. It gives a yellow colour with hypochlorite of lime.

Formula of hydrated acid.....	$C_{18} H_9 O_7 + HO$
Formula of evernesiate of baryta..	$C_{18} H_9 O_7 + BaO + Aq.$
Formula of evernesiate of silver ..	$C_{18} H_9 O_7 + AgO.$

Orcin.

This substance is always obtained when any of the colouring principles of the lichens which yield red dyes with ammonia are subjected to particular processes. The best way of obtaining it pure is to boil the alpha-, or beta-orsellesic acid, or the erythrelesic acid in water for about an hour. Carbonic acid is given off, and crystals of colourless orcin are deposited. It gives a dark purple red colour with hypochlorite of lime, quickly changing into deep yellow.

Empirical formula..... $C_{16} H_{11} O_7$.

Brom-orceide, $C_{16} H_{24} Br O_{13}$ (empirical), is obtained by pouring bromine into a concentrated aqueous solution of orcin; when pure it forms long white adhering needles; it has no taste or smell.

Chlor-orceide, a similar compound, is obtained by passing chlorine gas through a solution of orcin.

Usnic Acid.

This principle is found in *Usnea florida, U. hirta, U. plicata, U. barbata, Ramalinea calicaris, R. Fraxinia, Evernia Prunastri,* and *Cladonia Rangeferina.* It is best obtained from *Cladonia Rangeferina* and *Usnea florida,* by the use of lime and muriatic acid.

Its empirical formula is $C_{38} H_{17} O_{14}$.

February 17, 1848.

GEORGE RENNIE, Esq., Treasurer, in the Chair.

"On a Formula for the Elastic Force of Vapour at different Temperatures." By Captain Shortrede. Communicated by Lieut.-Col. Sykes, F.R.S.

The author adopts as the basis of his formula the first series of experiments at high temperatures made by the French Academy, and those of Magnus at low temperatures. For the Academy's experiments, he adopts the indications of the smaller thermometer in the steam in preference to those of the larger thermometer in the water. Of Dr. Young's sort of formulæ, he notices that of the Academy and several others with exponents varying from 5 to 7. From the elasticity at freezing, as given by Magnus, compared with four of the Academy's experiments, he shows that for the range of obser-